

# **Sewer Sediment and Control**

## **A Management Practices Reference Guide**

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## **Notice**

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## **Foreword**

The U.S. Environmental Protection Agency (US EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, US EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threatens human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by US EPA's Office of Research and Development to assist the user community and to link researchers with their clients with specific emphasis on illustrating control of sewer sediment pollution.

Lee A. Mulkey, Acting Director  
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## **Abstract**

Sewer sediment is one of major sources of pollutants in urban wet-weather flow (WWF) discharges that include combined-sewer overflow (CSO), separate sanitary-sewer overflow (SSO), and stormwater runoff. During low-flow, dry-weather periods, sanitary wastewater solids deposited in combined sewers have significant adverse impacts on the integrity of the sewerage system and receiving-water quality. In the US, estimates of dry-weather flow deposition in combined sewers vary from 5 to 30% of the daily inputs of solids and pollutants. In Europe, average deposition rates have been measured at between 30 and 500 g/m/d. Even sewers that are supposedly designed to be ‘self-cleansing’ will have transient sediment deposits and part of the load in transport will move near the sewer invert.

Deposited organic matter contains high concentrations of sulfates that can be reduced to hydrogen sulfide ( $H_2S$ ) under anoxic conditions often reached in a sewer. The  $H_2S$  is then oxidized to sulfuric acid, a highly toxic and corrosive gas, by biochemical transformation. The concentration of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and ammonia ( $NH_3-N$ ) in sewer sediments can be as high as 150,000 mg/L, 200,000 mg/L, and 300 mg/L, respectively. During a storm event, resuspended sediments are discharged directly into receiving waters.

This report covers sources of sewer solids, sewer solids loading, sewer sediment and associated pollutants and their impacts, sewer cleaning, and in-sewer sediment control. For in-sewer sediment control, the report presents a number of in-sewer flushing systems with case studies.

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**Conversion Factors**  
**U.S. Customary to SI (Metric)**

| U.S. Customary Unit                   |                                       |                        | SI Unit                             |  |
|---------------------------------------|---------------------------------------|------------------------|-------------------------------------|--|
| Name                                  | Abbreviation                          | Multiplier             | Symbol                              | Name                                     |
| acre                                  | acre                                  | 0.405                  | ha                                  | hectare                                  |
| cubic foot                            | ft <sup>3</sup>                       | 28.32                  | L                                   | liter                                    |
| cubic feet per second                 | ft <sup>3</sup> /s                    | 28.32                  | L/s                                 | liters per second                        |
| cubic feet per square foot per minute | ft <sup>3</sup> /ft <sup>2</sup> /min | 0.305                  | m <sup>3</sup> /m <sup>2</sup> /min | cubic meters per square meter per minute |
| cubic inch                            | in. <sup>3</sup>                      | 0.0164                 | L                                   | liter                                    |
| cubic yard                            | yd <sup>3</sup>                       | 0.765                  | m <sup>3</sup>                      | cubic meter                              |
| degrees Fahrenheit                    | °F                                    | 0.555 (°F-32)          | °C                                  | degrees Celsius                          |
| feet per minute                       | ft/min                                | 0.00508                | m/s                                 | meters per second                        |
| feet per second                       | ft/s                                  | 0.305                  | m/s                                 | meters per second                        |
| feet                                  | ft                                    | 0.305                  | m                                   | meter(s)                                 |
| gallon                                | gal                                   | 3.785                  | L                                   | liter                                    |
| gallons per acre per day              | gal/acre/d                            | 9.353                  | L/ha/d                              | liters per hectare per day               |
| gallons per capita per day            | gpcd                                  | 3.785                  | Lpcd                                | liters per capita per day                |
| gallons per day                       | gal/d                                 | 4.381x10 <sup>-5</sup> | L/s                                 | liters per second                        |
| gallons per minute                    | gal/min                               | 0.0631                 | L/s                                 | liters per second                        |
| inch                                  | in.                                   | 2.54                   | cm                                  | centimeter                               |
| mile                                  | mi                                    | 1.609                  | km                                  | kilometer                                |
| million gallons                       | Mgal                                  | 3785.0                 | m <sup>3</sup>                      | cubic meters                             |
| million gallons per acre              | Mgal/acre                             | 8353                   | m <sup>3</sup> /ha                  | cubic meters per hectare                 |
| million gallons per acre per day      | Mgal/acre/d                           | 0.039                  | m <sup>3</sup> /m <sup>2</sup> /h   | cubic meters per square meter per hour   |
| million gallons per day               | Mgal/d                                | 0.0438                 | m <sup>3</sup> /s                   | cubic meters per second                  |

**Conversion Factors**  
**U.S. Customary to SI (Metric)**

| U.S. Customary Unit            |                          |            | SI Unit            |                                    |
|--------------------------------|--------------------------|------------|--------------------|------------------------------------|
| Name                           | Abbreviation             | Multiplier | Symbol             | Name                               |
| parts per billion              | ppb                      | 1.0        | $\mu\text{g/L}$    | micrograms per liter               |
| parts per million              | ppm                      | 1.0        | mg/L               | milligrams per liter               |
| pound                          | lb                       | 0.454      | kg                 | kilogram                           |
| pounds per acre per day        | lb/acre/d                | 1.121      | kg/ha/d            | kilograms per hectare per day      |
| pounds per cubic foot          | lb/ft <sup>3</sup>       | 16.018     | kg/m <sup>3</sup>  | kilograms per cubic meter          |
| pounds per million gallons     | lb/Mgal                  | 0.120      | mg/L               | milligrams per liter               |
| pounds per square foot         | lb/ft <sup>2</sup>       | 4.882      | kg/m <sup>2</sup>  | kilograms per square meter         |
| pounds per square inch         | lb/in. <sup>2</sup>      | 0.0703     | kg/cm <sup>2</sup> | kilograms per square centimeter    |
| square foot                    | ft <sup>2</sup>          | 0.0929     | m <sup>2</sup>     | square meter                       |
| square inch                    | in. <sup>2</sup>         | 6.452      | cm <sup>2</sup>    | square centimeter                  |
| square mile                    | mi <sup>2</sup>          | 2.590      | km <sup>2</sup>    | square kilometer                   |
| square yard                    | yd <sup>2</sup>          | 0.836      | m <sup>2</sup>     | square meter                       |
| standard cubic feet per minute | std ft <sup>3</sup> /min | 1.699      | m <sup>3</sup> /h  | cubic meters per hour              |
| ton (short)                    | ton (short)              | 0.907      | Mg (or t)          | 1,000 kilograms (0.907 metric ton) |
| tons per acre                  | ton/acre                 | 2240       | kg/ha              | kilograms per hectare              |
| tons per square mile           | ton/mi <sup>2</sup>      | 3.503      | kg/ha              | kilograms per hectare              |
| yard                           | yd                       | 0.914      | m                  | meter                              |

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